Socio-Economic Planning Sciences xxx (xxxx) xxx

Contents lists available at ScienceDirect

Socio-Economic Planning Sciences

journal homepage: http://www.elsevier.com/locate/seps

Health tourism strategy selection via SWOT analysis and integrated hesitant fuzzy linguistic AHP-MABAC approach

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ARTICLE INFO

Keywords:
Health tourism
Health tourism strategy selection
SWOT analysis
Hesitant fuzzy linguistic term set
AHP
MABAC

ABSTRACT

Health tourism focuses on the organizational and operational aspects of commercial trips for the treatment of individuals. In line with the economic growth, the industry has evolved significantly in the last few decades. Istanbul, Turkey is considered as one of the most viable markets in the region due to its thermal resources, mild climate, geographical accessibility, and natural resources. This study aims to present the SWOT analysis of Istanbul's health tourism with integrated hesitant fuzzy linguistic (HFL) AHP-HFL MABAC methodology to select the best strategy for its effective implementation. The proposed methodology initially determines SWOT factors required for the analysis. These factors are then weighted with HFL AHP. The results are then utilized to select the best health tourism strategy using HFL MABAC. The applicability of this approach is presented through a case study. This is the first study to propose an analytic based SWOT analysis with integrated HFL methods for the selection of most appealing health tourism strategy.

1. Introduction

Health tourism refers to national and international trips of individuals for the betterment of their health. Any trip with the primary goal being the treatment of individuals as well as preservation of their well-being is investigated under health tourism. The supply includes various options such as thermal, spa and wellness, and medical [1,2]. The industry also allows niche operations whose core business solely focus on a well-defined client segment, such as elderly population or people with disabilities.

Health tourism includes the following services [3,4]:

- Medical and physical improvement of patients through treatment alternatives such as massage, herbal therapy, and spring water.
- Rehabilitation through treatment alternatives such as hemodialysis, dependency program, and geriatric dispensatories.
- Disease treatment through treatment alternatives such as plastic surgery, oncological surgery, eye surgery, and cardiovascular surgery.

In Turkey, strategic planning and promotion of health tourism is carried out by the Ministry of Development. The responsibility of accommodation related regulations are directed via the Ministry of Culture and Tourism. Establishment of hospitals, dispensatories and other related institutions, in addition to the training of health service providers and the control of the overall health system are governed by the Ministry of Health [5].

Despite the well-defined roles and responsibilities of related governmental organizations and the great advantages the country offers, health tourism potential of Turkey is still underutilized due to the lack of strategic planning in this relatively new industry. To investigate how a region can be well-positioned to compete in this growing market address, this study aims to develop and evaluate various strategies for health tourism in Turkey, using Istanbul as a case study. In this regard, strategic evaluations and suggestions on how to position Istanbul's current position are presented. Strategic evaluation of the health tourism in Istanbul is conducted through a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis [6].

Since solely qualitative SWOT may be insufficient to prioritize SWOT factors, the literature offers some research utilizing quantified SWOT analysis. The first quantified SWOT methodology with integration of AHP has been introduced by Kurttila et al. [9]. SWOT analysis is also used in conjunction with other multi-criteria decision making (MCDM) methods with or without uncertainty [10–13]. However, to the best of

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https://doi.org/10.1016/j.seps.2020.100929
Received 25 May 2020; Received in revised form 31 July 2020; Accepted 31 July 2020
Available online 20 August 2020
0038-0121/

our knowledge, this is the first study that proposes SWOT analysis with integrated hesitant fuzzy linguistic (HFL) AHP-HFL MABAC methodology in order to structure and rank the SWOT factors for health tourism and to select the best health tourism strategy. In the literature, SWOT analysis is generally supported by fuzzy-based methods. Adem et al. [14] proposed the only SWOT analysis with HFL. The study employs an advanced fuzzy-based technique, the HFL approach, in conjunction with various MCDM techniques.

Decision making can be broadly defined as the choice between two or more alternatives. MCDM processes require the criteria and alternatives to be evaluated by Decision Makers (DMs) as the first step [15]. However, DMs often encounter difficulties when expressing their thoughts by numbers since quantitative values are not compatible with every day intuitive thinking. That is, DMs are usually more comfortable stating their preferences using words instead of crisp numbers. The MCDM based on hesitant fuzzy linguistic term set (HFLTS) is used to represent the evaluation made by the experts in a more realistic way [16].

In order to embed strategic thinking into the model environment, this study uses SWOT methodology in conjunction with HFL AHP and HFL MABAC. The HFL AHP approach is used to assess the importance degree of factors in each SWOT group and the significance of factors, while HFL MABAC is used to assess health tourism strategies with respect to SWOT factors. AHP method is one of the most preferred MCDM techniques due to its simple structure and its ability to deal with complex decision problems [17]. The MABAC is a method used for ranking the alternatives. The MCDM method focuses on defining the distance of the criteria of each observed alternative from the border approximate area [18].

The integrated HFL MABAC method has been used in combination with different MCDM methods such as COPRAS, CODAS, MAIRCA etc. [19–21]. However, there is no study on the combined HFL AHP-HFL MABAC methodology in the literature. This methodology is applied for the first time in the field of health tourism. The combination of HFLTS and MCDM tools brings decision problems closer to real life. HFLTS provides DMs with the flexibility in eliciting linguistic options. As a result, the consistent HFL AHP- HFL MABAC methodology becomes an effective, flexible, adaptable and a valid tool to achieve accurate and reliable results.

The three main contributions of this study are as follows:

- This article contributes to the literature by proposing a quantitative-based SWOT analysis with integrated HFL methods for health tourism strategy selection for the first time. This analysis is a systematic tool to manage decision which becomes a stronger evaluation approach processes when supported by analytical methods. This quantitative measurement is provided by the integration of HFL methods. This study demonstrates how verbal information can be useful for MCDM and how HFL methods are utilized in the case of hesitancy. Therefore, the approach provides more realistic results during the evaluation of alternatives allowing a more flexible environment for the decision-makers.
- This study uses the SWOT methodology with HFL AHP and HFL MABAC for the first time. The AHP method is one of the most preferred MCDM techniques and the MABAC method is a relatively new distance-based alternative ranking technique. There is no study on the combined HFL AHP-HFL MABAC methodology in the literature.
- The proposed evaluation framework as well as its application to a case study in İstanbul is also among the significant contributions to the practical field. The analysis and accompanying findings provide guidance to managers attempting to determine the most appropriate strategies for health tourism.

The study has been organized as follows. The following section provides an outlook of health tourism related studies with and without SWOT analysis. The third section details the SWOT-based methodology. Section 4 presents the methods utilized in this paper. This methodology is illustrated through a real life case study in Section 5. Section 6 presents the comparative analysis and managerial insights and discussion are introduced in Section 7. Concluding remarks for future research are provided in the final section.

2. Health tourism

2.1. Region analysis for health tourism

Economic growth of nations coupled with increasing life expectancy has contributed to the rising demand for health care services. Health tourism is one of the industries that has become more significant for various countries. Although leisure is still at the forefront, health tours during holidays are becoming a permanent part of tourism operations [22]. This change is also observed in the rising numbers academic literature relating to health tourism. In the literature, these studies generally can be divided into three categories such as region analysis, theoretical approach and case studies with specific focus.

As it can be observed from literature survey of health tourism, regional analysis is among the most studies subjects. Among these, Sayili et al. [23] described Kangal Fish Spring as the destination of health tourism and explored the socio-economic characteristics of people visiting this area. Gustavo [24] presented the medical tourism while Lee [25] analyzed the role of the health care sector in Singapore. Altın et al. [3] investigated the development of essential medical tourism in Turkey for both public and private sectors. Yu and Ko [26] presented the health tourism perceptions and participation of Chinese, Japanese, and Korean visitors in Jeju Island, Korea. Jadhav et al. [27] assessed best practices in terms of stakeholders' view of international health tourism. Chanin et al. [28] examined Middle Eastern tourist behaviors and needs for health tourism, and health tourism management guidelines for these tourists. Crooks et al. [29] evaluated the healthcare tourism in Canada, while Drăghici et al. [30] have determined the role of health tourism in the development of regional systems in Romania between 2000 and 2012, a period of great transformations in this economic sector. Ohe et al. [31] evaluated the relaxation effects of emerging forest-therapy tourism in Japan, while Ganguli and Ebrahim [32] analyzed Singapore's medical tourism competitiveness. Page et al. [33] presented wellness tourism, coastal tourism and small business development in a UK coastal resort. Aydın and Karamehmet [34] presented a model of international healthcare facility choice with factors affecting health tourism in Turkey. Ridderstaat et al. [35] investigated the impact of key tourist markets on health tourism in the United States. The general concept of health tourism in Italy is presented with statistical models by Manna et al. [2]. Salehi-Esfahani et al. [36] presented the volume and price effects of health tourism for years between 1986 and 2016. Moghadam et al. [37] investigated the role of the medical sensitivities of international patients in the medical tourism marketing. A model for health tourism in low mountains is proposed [38].

Considering the importance of the topic and the number of the studies in the literature, this study will also analyze the region.

2.2. SWOT combined health tourism

Health tourism has seen a significant growth and has been improving globally in the last decades. In this regard, the literature offers a large variety of health tourism related studies focusing on particular cities and countries. Out of these, studies utilizing SWOT analysis are shown in Table 1.

As it can be observed from Table 1, Ataberk and Baykal [40] explained that Dikili, one of the places with coastal tourism, has the natural and cultural resources required for ecotourism and thermal tourism. Barca et al. [45] identified the current state of health tourism in Turkey to assess the recent developments. Advantages and

Table 1
Literature review of the health tourism and SWOT analysis.

Year	Authors	The aim of the study	Region	Identification of strategy	Analytic technique
2009	Hannam [39]	Marketing of Kerala as a center of non-western healthcare tourism	Kerala, India	–	–
2011	Ataberk & Baykal [40]	Utilization of natural and cultural sources for health tourism	Dikili, Izmir	–	–
2011	Fabac & Zver [41]	Region analysis	Gornje Međimurj, Croatia	+	AHP
2012	Marinoski & Korunovski [42]	Tourism in Macedonia amid changing environment	Macedonia	–	–
2013	Kim et al. [43]	Evaluation of medical tourism development	Korea	–	–
2013	Maini [44]	Examination of health tourism industry	India	+	–
2013	Barca et al. [45]	Strategic analysis of health tourism	Turkey	+	–
2013	Ebrahimzadeh et al. [46]	Comparison of countries for health tourism potentials	Iran, India	+	AHP
2013	Picazo [47]	Analysis of medical tourism industry	Philippines	+	–
2014	Edinsel & Adıgüzel [48]	Development of health tourism in Turkey over the last five years	Turkey	–	–
2014	Daştan [49]	Analysis of health tourism practices of public and private health organizations	Izmir	+	–
2014	Aslan et al. [50]	Strategy development for Turkish healthcare services	Turkey	+	–
2014	Ghanbari et al. [51]	Presentation of strategic of medical tourism development	Ahwaz, Iran	+	–
2014	Wong et al. [52]	Presentation of comparative analysis of countries for medical tourism	Malaysia, Thailand, Singapore, India	–	–
2015	Dincer et al. [53]	Effects of the change process in the global tourism sector	Islamic Countries	+	–
2015	Hosseini et al. [54]	Presentation of the development strategic of health tourism	Iran	–	–
2015	Emir & Arslanturk [55]	Analysis of thermal tourism with the perspective of tourism students	Afyonkarahisar	–	–
2015	Ajmera et al. [4]	Prioritization of SWOT factors of health tourism	India	+	AHP
2015	Goodarzi et al. [56]	Planning and development of wellness tourism	Sareyn, Iran	–	–
2016	Görener [57]	Evaluation of medical tourism sector	Turkey	+	AHP
2016	Tasci & Görener [58]	Strategic analysis of medical tourism sector	Turkey	+	AHP - MOORA
2016	Ulaş & Anadol [59]	Investigation of private hospitals for medical tourism	Turkey	+	–
2017	Anish et al. [60]	Strategic analysis of medical tourism	Kerala, India	+	AHP
2017	Khairunnisa & Hatta [61]	Development of health tourism industries	Malaysia	+	–
2017	Unuvar et al. [62]	The corporate social responsibility for health tourism	Turkey	–	–
2017	Mohezar et al. [63]	Challenges of the Islamic health tourism sector	Malaysia	+	–
2017	Ajmera [64]	Ranking the medical tourism strategies	India	+	TOPSIS
2018	Abadi et al. [65]	Presentation of strategic development framework for health tourism	Yazd, Iran	+	BWM
2018	Olyaeemanesh et al. [66]	The health system transformation plan	Iran	+	–
2018	Shablii et al. [67]	The problems of health tourism	Ukraine	–	–
2018	Zarchi et al. [68]	Strategic analysis of medical tourism	Shiraz, Iran	–	–
2019	Dragičević & Paleka [69]	Financial effects and potentials of health tourism	Poland, Croatia	–	–
2019	Zouni & Gkougkoulitsas [70]	Presentation of tourism marketing strategies for health tourism	Thessaloniki, Greece	+	–

disadvantages of Turkey's health tourism along with future opportunities and with alternative tourism opportunities that realized in the past five years are evaluated by Edinsel and Adıgüzel [48]. Daştan [49] examined the current state of the health tourism sector in Turkey and in Izmir analyzing the impact of health tourism's contribution to Turkey and Izmir. The authors used SWOT analysis and provided several suggestions to improve Turkey's share in the global health tourism market. Structural changes that forced Turkey to restructure the developing health system are presented by Aslan et al. [50] while Emir and Arslanturk [55] analyzed the SWOT of thermal tourism based on the perceptions of tourism students.

It is evident by this literature survey that related literature lacks SWOT analysis related studies focusing on Istanbul despite the fact that it is the most populous city in Turkey with ample resources for accommodations and health care. With these motivations, this study applies SWOT to determine the factors of region analysis considering its geographic location and cultural structure as well as its economic and health sector capacity.

As seen in Table 1, SWOT analysis on health tourism is used in combination with various MCDM techniques such as AHP, TOPSIS, MOORA, BWM. However, there is no study in the literature that utilizes SWOT analysis for health tourism with advanced fuzzy MCDM techniques. In this study, SWOT analysis is integrated with HFL AHP-HFL MABAC techniques.

3. SWOT-based methodology

The SWOT analysis, first presented by the American business and management consultant Albert S. Humphrey, is defined as a tool that deals with complex strategic situations by presenting and organizing information in a clear way for decision making [7]. The method aims to increase strengths, and to remove or reduce weaknesses while evaluating opportunities and identifying threats [8]. SWOT factors are customarily obtained through a qualitative framework. In line with its popularity, related literature offers a large variety of qualitative studies focusing on utilizing SWOT models for health tourism. However, the literature lacks a systematic, integrated and quantitative approach. Aiming at filling this gap, this study proposes an advanced SWOT-based quantitative method.

SWOT analysis is a strategic approach which is used to determine the strengths and weaknesses of a situation to be assessed, and to identify opportunities and threats taking into account both internal and external factors contributing to the problem environment. The approach uses both positive and negative internal and external factors holistically to assess the situation and ensure success [53]. SWOT analysis has two major benefits. First, SWOT analysis is performed to analyze the current situation. In this step, the strengths and weaknesses of the situation along with the opportunities and threats are revealed. In this sense SWOT can be considered as a "current situation" analysis tool. It is however, also an analytical technique that predicts how the future state of the current situation will be. With this predictive ability, SWOT can

also be regarded as a "future situation" analysis tool.

SWOT analysis also has limitations such as prohibiting the quantification of each factor in the decision making process. This shortcoming makes it difficult to determine the impact of SWOT factors on strategic decisions. Using the approach in conjunction with the AHP technique overcomes this challenge [9]. With this thought in mind, proposed integrated model utilizes SWOT analysis as a state-configuration approach to support the HFL AHP and HFL MABAC methods in decision-making.

Effectiveness of decision making is heavily reliant on the consideration of all internal and external factors that are included in the problem environment. SWOT analysis is systematic tool to support decision processes. SWOT analysis also helps develop strategies within the scope of identified opportunity, threat, strengths and weaknesses. The HFL AHP is commonly employed to define final relative weights and priority factors in any given MCDM problem. The method is based on pairwise comparisons with hesitant judgments and provides the managers with state control capability helping them classify targets and paths in complex decision environments [71]. The third method employed in this study is HFL MABAC, an additional MCDM method which evaluates given alternatives and determines their distances to the optimal solution to select the best strategy [19].

Combining these three approaches, this study integrates SWOT analysis with HFL AHP and HFL MABAC to prioritize the SWOT factors for health tourism strategy selection. In decision-making problems, the use of linguistic information instead of numerical information is more intuitive and meaningful defined closer to the real life. In such cases, the hesitant fuzzy linguistic approach represents linguistic information using linguistic variables. The use of hesitant fuzzy linguistic information provides a flexibility in decision making with realistic results [72].

The flowchart of this methodology is provided in Fig. 1.

4. Utilized HFL-based methods

4.1. Preliminaries of the HFLTS

The complexity of real life decision problems can often be attributed to the uncertainty associated with the alternatives. Using linguistic information is one way to manage this uncertainty. Efficient decision making becomes difficult in cases where experts are expected to select among various criteria with insufficient information. Hesitant fuzzy MCDM approach deals with comparative HFLTS to reveal information in hesitate situations and is appropriate for cases where the information is limited.

Hesitant fuzzy set (HFS) is first proposed by Torra [16]. In HFSs, the degree of membership of an element may have many possible values between zero and one. HFS is strongly useful in expressing hesitation during evaluation and hence are a popular choice of researchers dealing with high levels of uncertainty. Liu and Rodriguez [72] presented an MCDM model where DMs expressed their evaluations via linguistic expressions using a set of HFLTS.

X is defined as a set. HFS is a function and subset of [0, 1], which can be presented as [16]:

$$E = \{ < x,\ h_E\ (x) > | x \in X \} \tag{1}$$

$M = \{\mu_1, \mu_2, \ldots, \mu_n\}$ is defined as a set of membership functions n. The HFS is associated with M, h_M, is described as

$$h_M: M \rightarrow \{[0,\ 1]\} \tag{2}$$

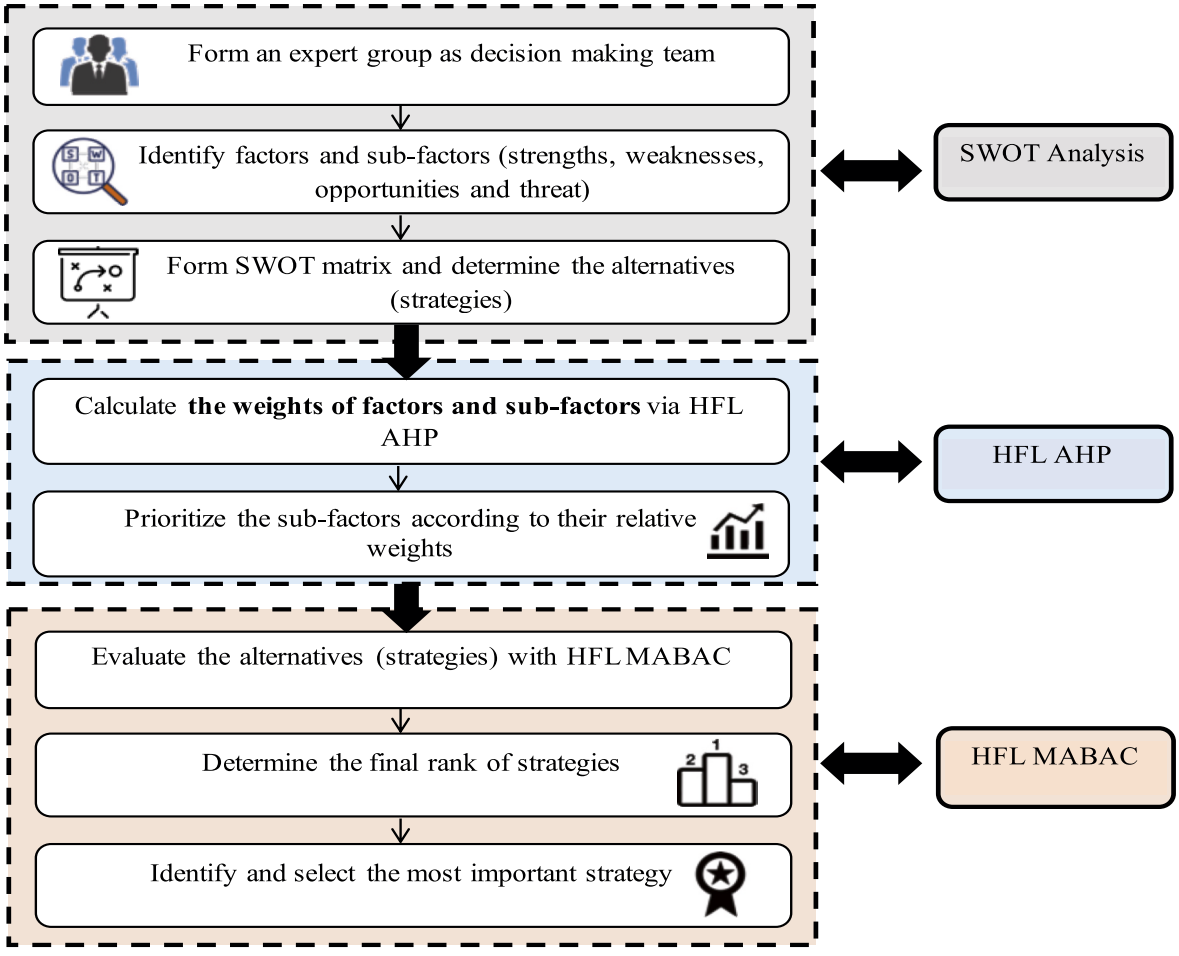


Fig. 1. The flowchart of proposed methodology.

$$h_M(x) = \underset{\mu \in M}{U}\{\mu(x)\} \quad (3)$$

S is defined as a set of linguistic terms, $S = \{s_0, \ldots, s_g\}$. An HFLTS, H_s, is an ordered finite subset of the sequential linguistic terms of S.

E_{GH} is a function that transforms expressions in words into HFLTS, H_S. G_H is an out-of-context grammar that utilizes the linguistic term set in S. S_{ll} is the expression domain generated by G_H. This relationship can be represented as

$$E_{GH}: S_{ll} \rightarrow H_s \quad (4)$$

Using the following approach, comparative linguistic expressions can be transformed into HFLTS:

$$E_{GH}(s_i) = \{s_i | s_i \in S\} \quad (5)$$

$$E_{GH}(\text{at most } s_i) = \{s_j | s_j \in S \text{ and } s_j \leq s_i\} \quad (6)$$

$$E_{GH}(\text{less than } s_i) = \{s_j | s_j \in S \text{ and } s_j < s_i\} \quad (7)$$

$$E_{GH}(\text{at least } s_i) = \{s_j | s_j \in S \text{ and } s_j \geq s_i\} \quad (8)$$

$$E_{GH}(\text{greater than } s_i) = \{s_j | s_j \in S \text{ and } s_j > s_i\} \quad (9)$$

$$E_{GH}(\text{between } s_i \text{ and } s_j) = \{s_k | s_k \in S \text{ and } s_i \leq s_k \leq s_j\} \quad (10)$$

The envelope of the HFLTS, $env(H_S)$, is a linguistic interval with the upper bound H_{s+} and the lower bound H_{s-} as shown below:

$$env(H_S) = [H_{s-}, H_{s+}],\ H_{s-} \leq H_{s+} \quad (11)$$

The use of the linguistic expressions brings to the model environment two main advantages:

- The use of linguistic term sets with hesitancy provides ease in decision-making process since the method allows DMs to express their ideas using linguistic expressions. Furthermore, the model provides a large span of linguistic expression alternatives due to the high elasticity of the model [73,74,88].
- This is also useful for organic adaption of the expressions preserving their unique nature. With this ability, HFLTS becomes a preferred method when there are numerous factors to be considered. Selecting the best strategy for health tourism involves consideration of high numbers of criteria and hence provides a great opportunity for its utilization [71,73].

4.2. HFL AHP method

In this study, HFL AHP methods are used to determine the relative importance of SWOT factors. AHP, first introduced by Saaty [17], is the most widely applied model in decision making. It is a strong and simple decision-making tool that prioritizes various factors. Hesitancy is a common phenomenon in the decision making process.

HFL AHP is generally used if the decision-making process involved uncertainty. The judgments represented by several possible values are called as a hesitant judgment [73]. In recent years, the use of this method has been increasing in the literature. Büyüközkan et al. [74] used this method for renewable energy selection for United Nations' sustainable development goals. Mi et al. [75] presented hesitant AHP method with consistency checking in used-car management. Büyüközkan and Güler [76] analyzed the companies' digital maturity with hesitant AHP. Ohta et al. [77] compared the classical, fuzzy, hesitant and intuitionistic AHP in industrial maintenance management area.

Let $A = \{a_1, a_2, \ldots, a_n\}$ be a set of values to be aggregated, F, the ordered weighted average operator OWA is defined as

$$F(a_1, a_2, \ldots, a_n) = wb^T = \sum_{i=1}^{n} w_i b_i \quad (12)$$

where $w = (w_1, w_2, \ldots, w_n)^T$ is a weighting vector, and $w_i \in [0, 1]$ with $\sum_{i=1}^{n} w_i = 1$ and b is the associated ordered value vector, where $b_i \in b$ is the ith largest value in A.

Following this, the HFL AHP model is utilized in order to generate priorities by following below listed steps:

Step 1. Pairwise comparison matrices are structured by DMs and the compromise evaluations are obtained with HFLTS using the linguistic terms in Table 2.

Step 2. Fuzzy envelope for HFLTS is aggregated and built with the OWA operator [72].

Step 3. The pairwise comparison matrix ($\tilde{C}$) generated in *Step 2* where $\tilde{c}_{ij} = (c_{ijl}, c_{ijm1}, c_{ijm2}, c_{iju})$. The reciprocal values then become:

$$\tilde{c}_{ij} = \left(\frac{1}{ciju}, \frac{1}{cijm2}, \frac{1}{cijm1}, \frac{1}{cijl}\right) \quad (13)$$

Step 4. The consistency of each pairwise comparison matrix is examined. To check the consistency, these matrices are de-fuzzified [78]. Considering TFN $A = (l, m_1, m_2, u)$, it is converted to crisp number by using Eq. (14).

$$\mu_d = \frac{l + m_1 + m_2 + u}{6} \quad (14)$$

Consistency ratio (CR) is calculated by using Eqs. (15) and (16).

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (15)$$

$$CR = \frac{CI}{RI} \quad (16)$$

where CI refers to consistency index, λ_{max} is the largest eigenvector of the matrix, n is the number of criteria and RI is the random index.

If the pairwise comparison matrices are not consistent, DMs must reevaluate these matrices.

Step 5. For each row ($\tilde{r}_i$) of the matrix $\tilde{C}$, fuzzy geometric mean is calculated using Eq. (17).

$$r_i^- = \left(c^- i1 \otimes c_{i2}^- \ldots \otimes c_{in}^-\right)^{1/n} \quad (17)$$

Step 6. The fuzzy weight ($\tilde{w}_i^{CR}$) of each main factor of SWOT is calculated with ($\tilde{r}_i$) values as in Eq. (18):

$$\tilde{w}_i^{CR} = \tilde{r}_i \otimes (\tilde{r}_1 \otimes \tilde{r}_2 \ldots \otimes \tilde{r}_n)^{-1} \quad (18)$$

Table 2
Linguistic scale for HFL AHP [71].

Linguistic terms	si	Abb.	TFN
Definitely high important	s10	(DHI)	(7,9,9)
Extremely high important	s9	(EXHI)	(5,7,9)
Essentially high important	s8	(ESHI)	(3,5,7)
Weakly high important	s7	(WHI)	(1,3,5)
Equally high important	s6	(EHI)	(1,1,3)
Exactly low important	s5	(EE)	(1,1,1)
Equally low important	s4	(ELI)	(0.33,1,1)
Weakly low important	s3	(WLI)	(0.2,0.33,1)
Essentially low important	s2	(ESLI)	(0.14,0.2,0.33)
Extremely low important	s1	(EXLI)	(0.11,0.14,0.2)
Definitely low important	s0	(DLI)	(0.11,0.11,0.14)

Step 7. The fuzzy global weights of sub-factors of SWOT are calculated.

$$\tilde{w}_{ij}^{G} = \tilde{w}_{i}^{CR} \times \tilde{w}_{j}^{CR} \tag{19}$$

where, $\tilde{w}_{ij}^{G}$ the global weight of sub-factors of SWOT.

Step 8. The trapezoidal fuzzy numbers $\tilde{w}_{ij}^{G}$ using Eq. (20) are defuzzified and the defuzzified values are normalized using Eq. (21).

$$w_{ij}^{G} = \frac{\alpha + 2\beta + 2\gamma + \delta}{6} \tag{20}$$

$$w_{ij}^{N} = \frac{w_{ij}^{G}}{\sum_{i}\sum_{j} w_{ij}^{G}} \tag{21}$$

For both the main and their sub-criteria, Steps 1–6 are repeated and the sub-criteria weights are obtained by using steps 7–8.

4.3. HFL MABAC method

In this study, HFL MABAC method is used to evaluate the health tourism strategies. The MABAC method was developed by Pamučar and Ćirović [18] in 2015 and was first used in forklift selection. One of the main principles of the MABAC method is the distance between the border approximation area and each alternative. This distance is measured using the HFLTS distance measure [79].

The advantages of the MABAC method can be listed as follows:

- The method can be applied with ease and in a short time due to its simple implementation steps.
- The comprehensive outcomes can be easily achieved, as the method takes into account the potential values of gains and losses.
- The method can be used to address issues associated with independent indicators.
- MABAC can be effectively combined with other approaches.

Although the MABAC method was newly developed, it was used in several studies with various MCDM methods and approaches. The use of the MABAC method with hesitancy was presented by Peng and Dai [19] for the first time. Additional MABAC studies integrated with the hesitancy are provided in Table 3.

In this study, the fuzzy envelope methodology is integrated into the HFL MABAC method. This hybrid method is then combined with HFL AHP. HFLTS is significantly different from other methodologies and inherits the advanced idea that HFS allows utilization of several possible values to indicate the degree to which elements belong to a certain set. These linguistic expressions are combined with the fuzzy envelope approach by reflecting the experts' thoughts in a realistic manner. The method offers DMs a comparative and rich linguistic term set for explicit expression. The use of phrases that are relevant to hesitant human nature leads to more accurate evaluations.

Based on these studies, the steps of the HFL MABAC are given as follows:

Step 1. DMs evaluate the alternatives by using the linguistic scale provided in Table 2.

Step 2. These linguistic expressions are converted to TFN by using fuzzy envelope [72].

Step 3. The fuzzy normalized matrix is built:

$$\tilde{R} = \left[\tilde{r}_{ij}\right]_{m\times n} \tag{22}$$

$$\tilde{r}_{ij} = \frac{y_{ij} - y_{i}^{-}}{y_{i}^{+} - y_{i}^{-}},\ j \in B; \tag{23}$$

$$\tilde{r}_{ij} = \frac{y_{ij} - y_{i}^{+}}{y_{i}^{+} - y_{i}^{-}},\ j \in C; \tag{24}$$

with $y_{i}^{+} = \max\ (y_{1r}, y_{2r}, \ldots, y_{mr})$ and $y_{i}^{-} = \min\ (y_{1l}, y_{2l}, \ldots, y_{ml})$. Here, B and C denote sets of benefit and cost criteria, respectively.

Step 4. The weighted normalized *matrix* is calculated using Eq. (25).

$$\tilde{U} = \left[\tilde{U}_{ij}\right]_{m\times n} \tag{25}$$

where $[\tilde{U}_{ij} = \tilde{r}_{ij}.\mathrm{w_i} + \mathrm{w_i}]$ and $\mathrm{w_i}$ denotes the weights of the factors.

Step 5. The *approximate* border area matrix is computed with Eq. (26).

Table 3
The comparison of different MABAC methods with hesitancy.

Year	Authors	Type	Integrated Techniques	Application Area	The Main Characteristics of the Method
2017	Peng & Dai [19]	Hesitant fuzzy soft sets	WASPAS - COPRAS	Software development project selection	• A modified MABAC method within the hesitant fuzzy soft environment is proposed to help DMs. • It has not linguistic variables.
2018	Sun et al. [79]	HFLTS	–	Patients' prioritization	• The projection measurement is essential for this method. It shows both the distance and the included angle between two elements.
2019	Peng & Li [20]	Hesitant fuzzy soft sets	WDBA - CODAS	Disaster management	• The value of membership may be multiple conceivable values in soft sets. The hesitant fuzzy soft sets denotes different preferences from different DMs and avoid overlooking any subjective intentions of DMs.
2019	Adar & Delice [21]	multi-criteria HFLTS	MAIRCA	Healthcare waste treatment technology selection	• This method functions with the words and present in an environment characterized by fuzzy information.
2019	Xu et al. [80]	heterogeneous information environment	–	Green supplier selection	• In this methodology, the criteria values are determined by heterogeneous information of the HFL, triangular fuzzy numbers (TFN), interval numbers, and real numbers.
2020	Liu et al. [81]	normal wiggly HFLTS	–	Evaluation of marine ecological security situation	• Its advantage is to automatically mine potential uncertain information from HFLTSs given by DMs, so as to obtain more advanced and accurate information representation, which not only retains the original HFL information but also obtains deeper uncertain information.
2020	Şahin & Altun [82]	Probabilistic single valued neutrosophic HFS	–	Best investment company selection	• This method is indicated by several possible values of truth membership degree, indeterminacy degree, falsity membership degree, and their probability values at the same time. • The sum of the probability values of each possible membership value doesn't have to be equal to one. It is more reasonable to assume the sum of probability values is less than or equal to one for each membership degree.

$$\tilde{B} = \prod_{j=1}^{m} U_{ij}^{1/m} \quad (26)$$

m denotes the total number of alternatives.

Step 6. The distances of the matrix elements of alternative from the border area is determined as:

$$\tilde{D} = U - \tilde{B} \quad (27)$$

Step 7. Alternatives ranking is obtained by computing criteria function values as the sum of the alternative distance from border-approximation-area. The overall value of the criteria function of alternatives is obtained adding up all the matrix elements per rows.

Step 8. The obtained values are defuzzified with Eq. (28) and ranked.

$$x_{ij} = \frac{\left[\left(U_{x_{ij}} - L_{x_{ij}}\right) + \left(M_{x_{ij}} - L_{x_{ij}}\right)\right]}{3} + L_{x_{ij}} \quad (28)$$

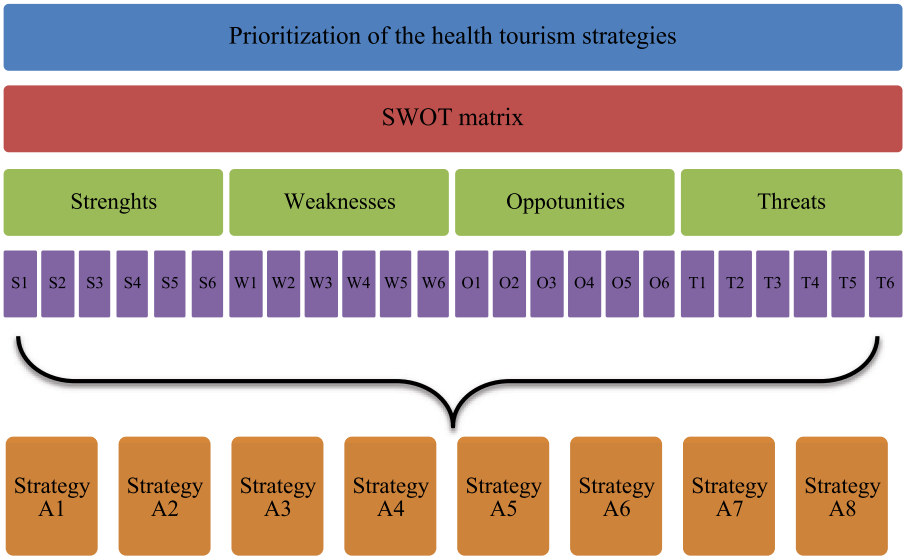
where $\tilde{x}_{ij} = (L_{x_{ij}}, M_{x_{ij}}, U_{x_{ij}})$.

5. Case study

In this section, the applicability of the proposed model is demonstrated with the help of a case study. Health tourism has been rapidly growing both in Turkey and globally and today presents a major potential source of revenue for countries. Compatible with its growth, major breakthroughs have been realized in Turkey over the past decade. The quality and efficiency of the health care system have been improved via several reforms both in public and private health sectors. Today, the health system in Turkey is functioning compatible with European standards with its modern hospitals, trained human power, experienced specialized physicians, and technological infrastructure. As a result of this developing trend, ABC, a tourism firm plans to invest in health tourism in Istanbul. The organization wants to investigate the health tourism potential of Istanbul considering all factors and to determine the best strategy for health tourism development. The existing alternative strategies are shown in Fig. 2.

To provide data for this problem, an extensive literature review is conducted on the subject and methods. Based on its findings, the authors decided to apply SWOT analysis in Istanbul to be able to cover all aspects of health tourism. The factors include 6 strengths, 6 weaknesses, 6 opportunities and 6 threats factors policies. The strengths, weaknesses, opportunities and threats regarding the problem environment are determined by the group of experts. The DM1 has over a decade experience in the tourism sector with a specialization on Istanbul's tourism development. DM2 holds extensive experience in the Turkish health sector. DM3 has 5 years of experience in sustainable growth and development of tourism in Turkey. All three experts are sufficiently knowledgeable and experienced in the field of health tourism.

These factors are then evaluated and weighted separately by experts according to the categories using the HFL AHP method. Following this, the HFL MABAC method is used to select the best strategy for health tourism with respect to the provided factors. In this case study, where DMs evaluations are sought, the Delphi method is used to build consensus by using a series of questionnaires. The Delphi method



- A1: The professionalization of the health personnel and training foreign language to them
- A2: Reviewing the rules visa-related issues and trying the best to stable the prices
- A3: Using ways and new advertising methods for developing the health tourism sector
- A4: The use of opportunities in clinical government systems and the expansion of supplementary insurance and contracts
- A5: Developing coordination mechanisms between public institutions and strengthening cooperation between public and private sector
- A6: Providing support for investment and planning and the creation of new models for land supply and the enterprise
- A7: Increasing international cooperation and agreements
- A8: Improving the physical and technical infrastructure in the field of health tourism

Fig. 2. The hierarchical SWOT model.

resembles DMs' foresight process [83], and is used for managing the interactions between the DMs. This method collects data from a panel of selected DMs since the information obtained through a panel is considered to be more reliable than that obtained from a single expert [84].

5.1. SWOT factors of health tourism in Istanbul

The SWOT factors are determined via the collected expert opinions, related studies and industry reports. These factors are listed in Fig. 3 [4,5,45,48–50,55,57,60,64].

Strengths: Health tourism in Istanbul has several strengths, one major one being SATURK, the health tourism institution. This institution is responsible for carrying out all health tourism activities in a coordinated manner. SATURK is also charged with the task to ensure that the analysis required for health tourism development is carried out in accordance with state policies [85]. Other strengths include additional healthcare institutions, specifically, education and research hospitals, which are highly developed in terms of technological infrastructure. In these hospitals, significant attention has been given to infrastructure with constant monitoring of utilized technologies [4]. Furthermore, the tourism sector in Turkey has been growing steadily due to the region's mild climate, long shorelines, natural beauty, historical and archeological sites, developing infrastructure and high quality accommodation facilities [45]. The area is also easily accessible since Turkey neighbors with various European, Central Asian and Middle Eastern countries. The country is geographically positioned to reach close to one billion individuals within 3-h flight radius [50]. The relative affordability of Istanbul health tourism compared to other European countries [57] is also an additional advantage.

Weaknesses: The major weaknesses of health tourism in Istanbul derive from current complex and uncoordinated legislations. The lack of cooperation between the Ministry of Culture and Tourism and the Ministry of Health result in both ministries working independent of one another within the scope of their duties, authorities and responsibilities [85]. In addition, the mobility that European Union countries provide to their citizens and physicians does not apply to Turkey. The lack of a National Health Accreditation System, insufficient number of accredited health institutions and weak coordination with foreign insurance companies impose further challenges to the health tourism sector in Istanbul [57]. Another weakness is caused by the inadequate knowledge of health personnel regarding international health legislations and patient rights. Communication barriers and inadequate quality of catering services directed to foreign patients are also among the weaknesses [48]. Safety concerns adversely affect health tourism and with insufficient medical travel promotion and marketing the problem will continue to exist.

Opportunities: Despite the issues Istanbul health tourism market faces, there are also significant opportunities in this market. Many health care providers including administrative and medical personnel living abroad have returned to Istanbul due to the recent developments in health tourism. This highly-trained workforce also has the ability to

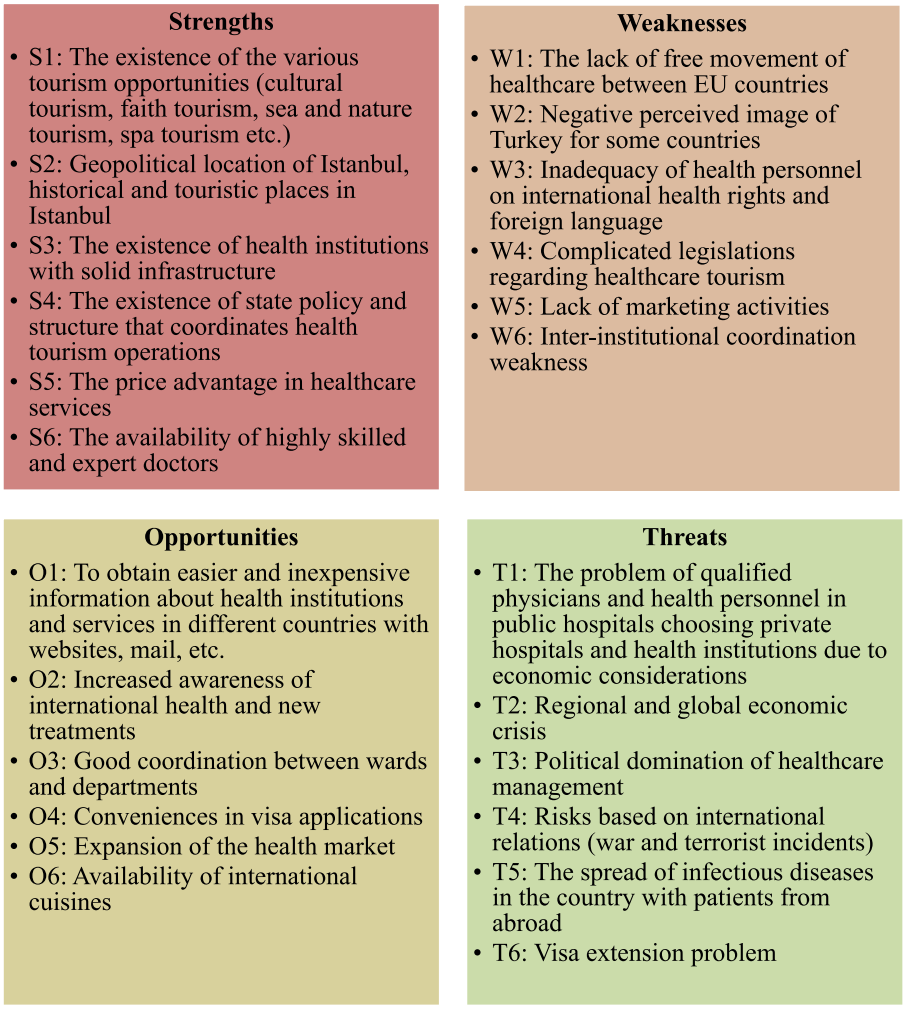


Fig. 3. SWOT factors considered for the case of Istanbul.

offer affordable high quality health care services compared to several European Union member countries and non-member states if necessary regulations are established. This addition would also increase the financial strength of related health institutions [60]. Health tourism is internationalized through the examination and standardization of the legislation applied in other countries. Another opportunity comes from the improvements in health tourism. In parallel with the developments in health tourism, opportunities for health related investments would see a significant increase. With increased investments, a brand value can be generated that would give Istanbul the ability to compete in the health tourism market with potential positive impact on the overall health industry [49].

Threats: Health tourism industry also faces several threats. Incompatible compensation of health care personnel and physicians can push high quality work force to alternative hospitals and health facilities which would lead to reduction of service quality in the overall sector. The spread of infectious diseases in the country with the patients from abroad constitutes another major threat [4]. In addition, it is possible that the quality of services offered to domestic population would be adversely affected due to the high volumes patients from abroad. Political dominance and crises in health management are also among the threats that need to be considered along with the additional financial burden brought by frequent changes in health legislations [85].

5.2. Developing strategies for health tourism

Gaining and remaining competitive advantage in the market place requires strategies that are aligned with the specific characteristics of the service providing region. Istanbul, chosen as a pilot city for this study, has a variety of strengths and weaknesses. Analyzed holistically, the factors indicate that Turkey is at the initial stages of health tourism development. Therefore, it is prudent to develop and implement strategies to gain a significant market share in the sector while building on its strengths and eliminating its weaknesses to achieve leadership role in this growing industry.

By using SWOT analysis, four strategic plans can be proposed [86]:

- SO: The good use of opportunities through existing strengths.
- ST: The good use of strengths to eliminate or reduce the impact of threats.
- WO: Taking into account weaknesses to obtain the benefits of opportunities.
- WT: Seeking to reduce the impact of threats by considering weaknesses.

In this regard, the strategies developed are detailed in the following. Strategies that are created with literature review and expert opinions according to the most important factors are as in Fig. 4.

5.3. Identification of SWOT factors' importance degrees by HFL AHP

Step 1. Firstly, the DMs evaluated the criteria with respects to others via the linguistic scale provided in Table 2. Table 4 presents the pairwise comparisons of the main SWOT factors and the DMs' evaluations using HFTLS. The pairwise comparisons of the sub-factors of SWOT are *constructed* as in Table 4.

Step 2. These linguistic expressions in Table 4 are aggregated and fuzzy envelope for HFLTS is built with the OWA operator. Geometric means and weights of each criterion are calculated with equations (17)-(18). Table 5 shows the normalized weights of the main factors of SWOT. In order to conduct a consistency check, the four main criteria are evaluated using pairwise comparison matrices. Lambda max, CI, and CR values are 4.124, 0.041, and 0.046, respectively. The resulting CR was highly satisfactory.

Step 3. Step 2 is applied for the sub-factors of SWOT to calculate relative scores reported in Table 6. Equations (19)-(21) are applied to calculate the global scores, as well as the defuzzified weights and normalized weights of the sub-criteria, as given in Table 6.

Finally, factors weights are calculated. The results indicate that "Risks based on international relations (war and terrorist incidents) (T4)" is the most important factor followed by "The existence of health institutions with solid infrastructure (S3)". Similarly, "The availability of highly skilled and expert doctors (S6)" is obtained as the third ranked

Table 4
Pairwise comparisons of the main SWOT factors.

	S	W	O	T
S	EE	Between ESHI and DHI	Between EHI and WHI	Between ELI and EHI
W		EE	Between ELI and EHI	Between ESLI and ELI
O			EE	Between EXLI and ESLI
T				EE

	Strenghts	Weaknesses
Opportunities	**SO Strategy:** • Increasing international cooperation and agreements (A7) • Improving the physical and technical infrastructure in the field of health tourism (A8)	**WO Strategy:** • Reviewing the rules visa-related issues and trying the best to stable the prices (A2) • The use of opportunities in clinical government systems and the expansion of supplementary insurance and contracts (A4)
Threats	**ST Strategy:** • Using ways and new advertising methods for developing the health tourism sector (A3) • Providing support for investment and planning and the creation of new models for land supply and the enterprise (A6)	**WT Strategy:** • The professionalization of the health personnel and training foreign language to them (A1) • Developing coordination mechanisms between public institutions and strengthening cooperation between the public and private sector (A5)

Fig. 4. Health tourism strategies.

Table 5
Pairwise comparison values and normalized weights of the main factors.

	S	W	O	T	Geometric Mean	Relative Scores
S	(1,1,1,1)	(3,6.78,7.22,9)	(1,1,3,5)	(0.33,1,1,3)	(0.997,1.614,2.157,3.409)	(0.109,0.297,0.479,1.335)
W	(0.11,0.14,0.15,0.33)	(1,1,1,1)	(0.33,1,1,3)	(0.14,0.32,0.34,1)	(0.267,0.460,0.475,0.997)	(0.029,0.085,0.105,0.391)
O	(0.2,0.33,1,1)	(0.33,1,1,3)	(1,1,1,1)	(0.11,0.14,0.2,0.33)	(0.292,0.464,0.669,0.997)	(0.032,0.085,0.148,0.391)
T	(0.33,1,1,3)	(1,3,3,7)	(3,5,7,9)	(1,1,1,1)	(0.997,1.968,2.141,3.708)	(0.109,0.362,0.475,1.452)

Table 6
Normalized weights of sub-factors of SWOT.

Sub-factors	Relative scores	Global scores	Priority of the group	Defuzzified weights	Normalized weights
S1	(0.011,0.026,0.038,0.126)	(0.001,0.008,0.018,0.168)	0.368	0.037	0.012
S2	(0.015,0.036,0.052,0.160)	(0.002,0.011,0.025,0.214)		0.048	0.016
S3	**(0.078,0.258,0.426,1.145)**	**(0.009,0.077,0.204,1.528)**		**0.350**	**0.117**
S4	(0.044,0.110,0.188,0.624)	(0.005,0.033,0.090,0.833)		0.180	0.060
S5	(0.031,0.086,0.150,0.477)	(0.003,0.026,0.072,0.637)		0.139	0.047
S6	**(0.092,0.289,0.391,1.145)**	**(0.010,0.086,0.187,1.528)**		**0.347**	**0.116**
W1	(0.014,0.039,0.058,0.212)	(0.000,0.003,0.006,0.083)	0.114	0.017	0.006
W2	(0.048,0.149,0.272,0.874)	(0.001,0.013,0.029,0.341)		0.071	0.024
W3	(0.105,0.315,0.569,1.453)	(0.003,0.027,0.060,0.567)		0.124	0.042
W4	(0.028,0.105,0.150,0.668)	(0.001,0.009,0.016,0.261)		0.052	0.017
W5	(0.020,0.069,0.109,0.401)	(0.001,0.006,0.012,0.157)		0.032	0.011
W6	(0.025,0.088,0.150,0.556)	(0.001,0.007,0.016,0.217)		0.044	0.015
O1	(0.011,0.024,0.036,0.117)	(0.000,0.002,0.005,0.046)	0.110	0.010	0.003
O2	(0.124,0.381,0.630,1.393)	(0.004,0.032,0.094,0.544)		0.133	0.045
O3	(0.039,0.111,0.207,0.728)	(0.001,0.009,0.031,0.284)		0.061	0.020
O4	(0.024,0.060,0.092,0.348)	(0.001,0.005,0.014,0.136)		0.029	0.010
O5	(0.051,0.128,0.228,0.759)	(0.002,0.011,0.034,0.297)		0.065	0.022
O6	(0.022,0.060,0.115,0.334)	(0.001,0.005,0.017,0.131)		0.029	0.010
T1	(0.011,0.022,0.034,0.100)	(0.001,0.008,0.016,0.145)	0.408	0.032	0.011
T2	(0.071,0.242,0.354,1.032)	(0.008,0.088,0.168,1.499)		0.336	0.113
T3	(0.029,0.072,0.130,0.468)	(0.003,0.026,0.062,0.680)		0.143	0.048
T4	**(0.086,0.242,0.390,1.124)**	**(0.009,0.088,0.185,1.632)**		**0.365**	**0.122**
T5	(0.050,0.166,0.293,0.824)	(0.005,0.060,0.139,1.196)		0.267	0.089
T6	(0.017,0.042,0.071,0.237)	(0.002,0.015,0.034,0.344)		0.074	0.025
				2.985	1

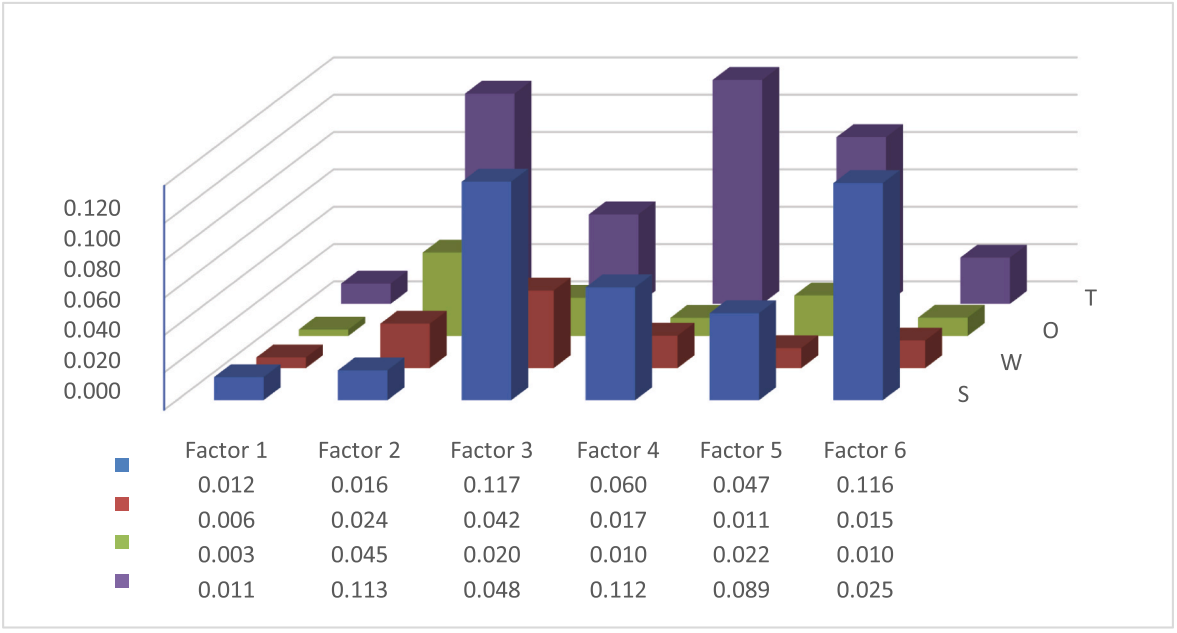


Fig. 5. The weights of SWOT factors.

Table 7
The evaluation matrix with linguistic terms with respect to strengths.

	S1	S2	S3	S4	S5	S6
A1	Between DLI and EXLI	Between DLI and EXLI	Between ESLI and ELI	Between WLI and ELI	Between ESLI and ELI	Between EXHI and DHI
A2	Between EXLI an WLI	Between ELI and EHI	Between EXLI and ESLI	Between ESLI and ELI	Between EHI and WHI	Between EXLI and ESLI
A3	Between ELI and EHI	Between ELI and EHI	Between WLI and ELI	Between EHI and WHI	Between ELI and EHI	Between EXLI an WLI
A4	Between EXLI an WLI	Between EXLI an WLI	Between WLI and ELI	Between EXHI and DHI	Between WHI and EXHI	Between WLI and ELI
A5	Between EXLI an WLI	Between EXLI and ESLI	Between WLI and ELI	Between EXHI and DHI	Between ESLI and ELI	Between ESLI and ELI
A6	Between ELI and EHI	Between WLI and ELI	Between ESHI and DHI	Between EHI and ESHI	Between ESLI and ELI	Between EXLI an WLI
A7	Between ELI and EHI	Between EHI and WHI	Between WLI and ELI	Between ELI and EHI	Between EXLI an WLI	Between ESLI and ELI
A8	Between EHI and WHI	Between EHI and WHI	Between EXHI and DHI	Between ELI and EHI	Between EXLI an WLI	Between DLI and EXLI

factor. The weights of SWOT factors are illustrated in Fig. 5.

5.4. Strategies' ranking by HFL MABAC

The MABAC method based on HFLTS was used to select the best strategy for health tourism industry with respect to various factors detailed in earlier steps.

Step 1. Firstly, SWOT factors and alternatives are evaluated by DMs using the linguistic scale given in Table 2. Table 7 provides an evaluation matrix of the sub-factors of Strengths and alternatives in addition to the evaluations of DMs using HFTLS. The rest of the evaluation matrices with linguistic terms with respect to weaknesses, opportunities and threats are structured similar to the data provided in Table 7.
Step 2. The linguistic expressions in Table 7 are aggregated and fuzzy envelope for HFLTS is built by using the OWA operator.
Step 3. The normalized fuzzy matrix is computed by using eqs. (22)–(24).
Step 4. The weighted normalized fuzzy matrix is calculated by using Eq. (25).
Step 5. The approximate border area matrix in Table 8 is computed by using Eq. (26).
Step 6. The distances of the matrix elements of alternative from border area are determined with Eq. (27). Finally, these values are defuzzified with Eq. (28) and the ranking of strategies are given in Table 9.

Table 8
The border approximation area matrix.

SWOT Factors	Border Approximation Area	SWOT Factors	Border Approximation Area
S1	(0.013,0.014,0.017)	W1	(0.010,0.011,0.011)
S2	(0.017,0.019,0.022)	W2	(0.038,0.043,0.046)
S3	(0.129,0.137,0.148)	W3	(0.073,0.078,0.080)
S4	(0.069,0.077,0.090)	W4	(0.027,0.031,0.034)
S5	(0.048,0.052,0.059)	W5	(0.019,0.020,0.021)
S6	(0.123,0.127,0.135)	W6	(0.023,0.026,0.028)
O1	(0.003,0.004,0.005)	T1	(0.019,0.021,0.022)
O2	(0.046,0.049,0.057)	T2	(0.188,0.213,0.222)
O3	(0.024,0.027,0.032)	T3	(0.075,0.087,0.093)
O4	(0.010,0.011,0.011)	T4	(0.203,0.228,0.239)
O5	(0.023,0.025,0.027)	T5	(0.096,0.165,0.177)
O6	(0.010,0.011,0.011)	T6	(0.044,0.046,0.048)

Table 9
Evaluation of strategies with respect to the SWOT factors.

Alternatives	Si			Defuzzification	Ranking
A1	−0.198	0.051	0.341	0.0645	2
A2	−0.318	−0.044	0.232	−0.0432	7
A3	−0.252	0.027	0.322	0.0321	5
A4	−0.227	0.057	0.353	0.0611	3
A5	−0.260	0.018	0.296	0.0179	6
A6	−0.331	0.055	0.423	0.0489	4
A7	−0.525	−0.122	0.250	−0.1321	8
A8	−0.133	0.093	0.368	0.1093	1

According to the results provided in Table 9, the best strategy is determined as the "Improving the physical and technical infrastructure in the field of health tourism (A8)". The other alternatives are ranked as:
$A8 \succ A1 \succ A4 \succ A6 \succ A3 \succ A5 \succ A2 \succ A7$.

6. The comparative analysis

To assess the robustness of the results of the HFL MABAC method, alternative strategies are evaluated via HFL TOPSIS. In this comparative analysis, identical HFL AHP results are used to clearly observe the effectiveness of the different ranking methods.

The TOPSIS is an effective method for evaluating and ranking alternatives among a pool of candidates. TOPSIS aims to ensure that the selected best alternative has the farthest distance from the negative-ideal solution and the shortest distance from the positive-ideal solution. This technique offers a valid solution to compare alternatives with respect to given criteria. HFL TOPSIS is a variant of TOPSIS and is specifically useful when there are limitations on the subjective expert input. In the presence of fuzziness, the TOPSIS technique can also be combined with the HFS. Beg and Rashid [87] presented a new method of aggregating the views of experts represented by HFLTS and used it for investment alternative selection.

The results obtained with HFL TOPSIS can be seen in Table 10.

The ranking of alternatives with HFL MABAC and HFL TOPSIS methods are illustrated in Fig. 6. According to the results, the solutions from these two methods for the evaluation of health tourism strategies produce similar results. The best health tourism strategy is again A8. In addition, the order of the second alternative is the same. These methods are similar in their approach and are both distance-based. However, the MABAC method is a relatively new and practical method compared to others. Compared to the outcomes of other prominent MCDM methods, this integrated HFL MABAC methodology provides highly consistent final values, proving the potential of the proposed method in solving similar MCDM problems.

7. Managerial implications and discussions

Health tourism has been growing rapidly as a result of various socioeconomic such as economic growth and aging population. These

Table 10
The final results of HFL TOPSIS.

	Di+	Di-	CC	Ranking
A1	23.621	0.379	0.0158	2
A2	23.800	0.200	0.0083	7
A3	23.721	0.279	0.0116	6
A4	23.691	0.309	0.0129	5
A5	23.686	0.314	0.0131	3
A6	23.685	0.315	0.0131	4
A7	23.847	0.153	0.0064	8
A8	23.597	0.403	0.0168	1

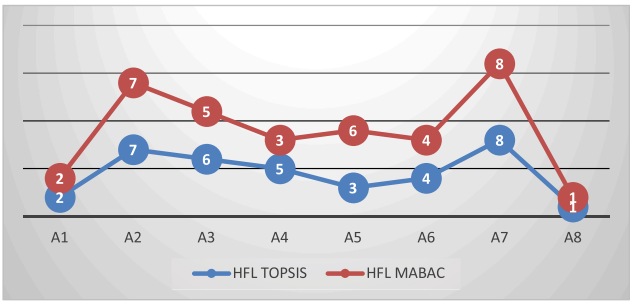


Fig. 6. The ranking of alternatives with HFL MABAC and HFL TOPSIS.

trends resulted in the emergence of several services industries. Out of these, the demand for health tourism is expected to grow. With this motivation, this study proposed an integrated model to determine the appropriate strategy for health tourism development. The proposed model can be useful to investors since it offers a reliable tool for the effective evaluation of health tourism strategic alternatives.

The hybrid model employed SWOT analysis in combination with the HFL AHP and HFL MABAC. The factors determined by the SWOT method are weighted using HFL AHP and the most appropriate strategy for health tourism is determined via HFL MABAC method. The results indicate that the most important factors were "Risks based on international relations (war and terrorist incidents) (T4)", "The existence of health institutions with solid infrastructure (S3)", and "The availability of highly skilled and expert doctors (S6)". The results of the HFL MABAC method show that the Company ABC should select the "Improving the physical and technical infrastructure in the field of health tourism (A8)" as the best health tourism strategy to invest in. The other alternatives are ranked as "The professionalization of the health personnel and training foreign language to them (A1)", "The use of opportunities in clinical government systems and the expansion of supplementary insurance and contracts (A4)", "Providing support for investment and planning and the creation of new models for land supply and the enterprise (A6)", "Using ways and new advertising methods for developing the health tourism sector (A3)", "Developing coordination mechanisms between public institutions and strengthening cooperation between public and private sector (A5)", "Reviewing the rules visa-related issues and trying the best to stable the prices (A2)", and "Increasing international cooperation and agreements (A7)", respectively:

In the literature, there are studies applying the SWOT analysis, the HFL AHP or the HFL MABAC separately. This study is the first in combining these three methods. This study considers the health tourism strategy selection process as an MCDM problem. This integrated evaluation method can help managers and researchers analyze the potential of the health tourism and make better informed decisions. The managers can utilize this study as a decision support system tool for making initial investment decisions during the development of health tourism industry.

8. Conclusion

Health tourism provides social and cultural formation opportunities for societies. Through its development, international interactions, communications and relations also improve. Given that medical trade is also evolving to become a global market, health tourism today can also be considered as one of the major driving forces in global health care providing countries with competitive advantage.

Among the tangible benefits, one can count the cash flow to be generated by this new industry which would also impact the healthcare and medical markets. With the development of healthcare related markets it is expected to see a rise in the numbers of new business and a reduction in the unemployment rate. This emerging market would also lead to increased information exchange between various parties with positive impact on the overall know-how and technological abilities of countries and regions. Resulting technological advancement, despite the fact that they originated from the effort to serve foreign patients, would also benefit domestic increases the level of satisfaction.

This study utilized SWOT analysis to study Istanbul's health tourism and to select the best strategy for its effective implementation. In addition to the findings from the SWOT analysis, weaknesses have been transformed into stronger directions by utilizing existing strengths. Strategies for evaluating opportunities have also been included as part of the analysis. Following this, an integrated HFL AHP and HFL MABAC method is presented to prioritize the SWOT factors and to determine the best health tourism strategy in Istanbul, Turkey. The results showed that the proposed method can be used effectively to determine a strategy with the highest priority. The strategic evaluation showed that Istanbul exhibited the characteristics of an actor "in the entrance hall" of the health tourism market implying the importance of establishing the right strategy to receive a significant share from this rapidly growing and high value-added sector.

Based on these results, the best strategy is "Improving the physical and technical infrastructure in the field of health tourism (A8)". With this strategy, the position against Istanbul's health tourism actors will be clearly defined. These actors include competitors, customers, new investors, suppliers, substitute sectors. Istanbul's position would be much better defined based on the date regarding current and potential competitors. This would also help in determining the areas where greater attention which would eventually lead to successful implementation of effective strategies.

The major contributions of this paper can be summarized as follows:

- To the best of the authors' knowledge, this article is the first study on these combined approaches. In this regard, the proposed study fills the gap in the literature by providing a quantified SWOT analysis based on HFLTS for health tourism strategy selection.
- It is the first paper which uses the SWOT analysis with integrated HFL AHP and HFL MABAC methodology.
- This article contributes to the health tourism strategy selection problem by developing a new evaluation model. It demonstrates the validation and the effectiveness of the presented approach via a case study that focuses on determining the most suitable health tourism strategy.

This study provides a systematic quantitative framework for selecting the best health tourism strategy. Proposed model is versatile and can be applied to the same industry using different factors and/or alternatives. It also has the ability to adopt to several other industries.

For the future, the problem can be addressed using aggregation operators for group decision making to aggregate DMs' assessments. In addition, as a second perspective, both HFL AHP and HFL MABAC methodologies could be performed with the extended fuzzy sets.

CRediT authorship contribution statement

Gülçin Büyüközkan: Conceptualization, Methodology, Resources, Investigation, Writing - review & editing, Project administration, Funding acquisition. **Esin Mukul:** Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft. **Elif Kongar:** Conceptualization, Methodology, Writing - review & editing.

Acknowledgements

The authors would like to express their deep gratitude towards industrial experts. The authors kindly thank the Editor and the anonymous reviewers for their valuable comments that helped improve the previous version of this paper. This work has been supported by the Scientific Research Projects Commission of Galatasaray University under grant numbers 19.402.003.

References

[1] Rodrigues H, Brochado A, Troilo M, Mohsin A. Mirror, mirror on the wall, who's the fairest of them all? A critical content analysis on medical tourism. Tour Manag Perspect 2017;24:16–25.
[2] Manna R, Cavallone M, Ciasullo MV, Palumbo R. Beyond the rhetoric of health tourism: shedding light on the reality of health tourism in Italy. Curr Issues Tourism 2019:1–15.
[3] Altın U, Bektaş G, Antep Z, İrban A. The international patient's portfolio and marketing of Turkish health tourism. Proc Soc Behav Sci 2012;58:1004–7.
[4] Ajmera P, Singh M, Satia HK. Prioritization of strengths, weaknsses, opportunities and threats of Indian medical tourism sector using integrated SWOT AHP analysis. Int J Innov Res Sci Eng Technol 2015;4(5):3665–73.
[5] Turkey Health Tourism Report. Health tourism status report and solution proposals in Turkey and in the world. 2010.
[6] Hill T, Westbrook R. SWOT analysis: it's time for a product recall. Long Range Plan 1997;30(1):46–52.
[7] Learned EP. Business policy: text and cases. RD Irwin; 1969.
[8] Dyson RG. Strategic development and SWOT analysis at the University of Warwick. Eur J Oper Res 2004;152(3):631–40.
[9] Kurttila M, Pesonen M, Kangas J, Kajanus M. Utilizing the analytic hierarchy process (AHP) in SWOT analysis—a hybrid method and its application to a forest-certification case. For Pol Econ 2000;1(1):41–52.
[10] Lee KL, Lin SC. A fuzzy quantified SWOT procedure for environmental evaluation of an international distribution center. Inf Sci 2008;178(2):531–49.
[11] Sanny L, Simamora BH, Polla JR, Atipa JL. Business strategy selection using SWOT analysis with ANP and fuzzy TOPSIS for improving competitive advantage. Pertanika J Soc Sci Hum 2018;26(2).
[12] Chen TL, Hsu HM, Pan SY, Chiang PC. Advances and challenges of implementing carbon offset mechanism for a low carbon economy: the Taiwanese experience. J Clean Prod 2019;239:117860.
[13] Solangi YA, Tan Q, Mirjat NH, Ali S. Evaluating the strategies for sustainable energy planning in Pakistan: an integrated SWOT-AHP and Fuzzy-TOPSIS approach. J Clean Prod 2019;236:117655.
[14] Adem A, Çolak A, Dağdeviren M. An integrated model using SWOT analysis and Hesitant fuzzy linguistic term set for evaluation occupational safety risks in life cycle of wind turbine. Saf Sci 2018;106:184–90.
[15] Hwang CL, Yoon K. Multiple attribute decision making—methods and applications. Berlin: Springer-Verlag; 1981.
[16] Torra V. Hesitant fuzzy sets. Int J Intell Syst 2010;25(6):529–39.
[17] Saaty TL. The analytic hierarchy process. New York: McGraw-Hill; 1980.
[18] Pamučar D, Ćirović G. The selection of transport and handling resources in logistics centers using Multi-Attributive Border Approximation area Comparison (MABAC). Expert Syst Appl 2015;42(6):3016–28.
[19] Peng X, Dai J. Hesitant fuzzy soft decision making methods based on WASPAS, MABAC and COPRAS with combined weights. J Intell Fuzzy Syst 2017;33(2):1313–25.
[20] Peng X, Li W. Algorithms for hesitant fuzzy soft decision making based on revised aggregation operators, WDBA and CODAS. J Intell Fuzzy Syst 2019;36(6):6307–23.
[21] Adar T, Delice EK. New integrated approaches based on MC-HFLTS for healthcare waste treatment technology selection. J Enterprise Inf Manag 2019;32(4):688–711.
[22] Yuan Z, Zhu Z, Yang H, Yu L, Chen G. On development strategies of TCM health tourism. In: 2017 international conference on economic development and education management (ICEDEM 2017). Atlantis Press; 2017, December.
[23] Sayili M, Akca H, Duman T, Esengun K. Psoriasis treatment via doctor fishes as part of health tourism: a case study of Kangal Fish Spring, Turkey. Tourism Manag 2007;28(2):625–9.
[24] Gustavo NS. A 21st-century approach to health tourism spas: the case of Portugal. J Hospit Tourism Manag 2010;17(1):127–35.
[25] Lee CG. Health care and tourism: evidence from Singapore. Tourism Manag 2010;31(4):486–8.
[26] Yu JY, Ko TG. A cross-cultural study of perceptions of medical tourism among Chinese, Japanese and Korean tourists in Korea. Tourism Manag 2012;33(1):80–8.
[27] Jadhav S, Yeravdekar R, Kulkarni M. Cross-border healthcare access in south Asian countries: learnings for sustainable healthcare tourism in India. Proc Soc Behav Sci 2014;157:109–17.
[28] Chanin O, Khunchumnan P, Amphansookko S, Thongyai K, Rodneum J, Sriprasert P. Guidelines on health tourism management for Middle Eastern tourists in Phuket Province. Proc Comput Sci 2015;65:1146–53.
[29] Crooks VA, Johnston R, Labonté R, Snyder J. Critically reflecting on Loh's "Trends and structural shifts in health tourism". Soc Sci Med 2016;152:186–9.
[30] Drăghici CC, Diaconu D, Teodorescu C, Pintilii RD, Ciobotaru AM. Health tourism contribution to the structural dynamics of the territorial systems with tourism functionality. Proc Environ Sci 2016;32:386–93.
[31] Ohe Y, Ikei H, Song C, Miyazaki Y. Evaluating the relaxation effects of emerging forest-therapy tourism: a multidisciplinary approach. Tourism Manag 2017;62:322–34.
[32] Ganguli S, Ebrahim AH. A qualitative analysis of Singapore's medical tourism competitiveness. Tourism Manag Perspect 2017;21:74–84.
[33] Page SJ, Hartwell H, Johns N, Fyall A, Ladkin A, Hemingway A. Case study: wellness, tourism and small business development in a UK coastal resort: public engagement in practice. Tourism Manag 2017;60:466–77.
[34] Aydin G, Karamehmet B. Factors affecting health tourism and international health-care facility choice. Int J Pharmaceut Healthc Market 2017;11(1):16–36.
[35] Ridderstaat J, Singh D, DeMicco F. The impact of major tourist markets on health tourism spending in the United States. J Dest Mark Manag 2019;11:270–80.
[36] Salehi-Esfahani S, Ridderstaat J, Ozturk AB. Health tourism in a developed country with a dominant tourism market: the case of the United States' travellers to Canada. Curr Issues Tourism 2020:1–18.
[37] Moghadam FN, Masoudi Asl I, Hessam S, Farahani MM. In search a medical tourism marketing pattern in Iran: the case of cultural sensitivities. Int J Healthc Manag 2020:1–6.
[38] Dunets AN, Yankovskaya V, Plisova AB, Mikhailova MV, Vakhrushev IB, Aleshko RA. Health tourism in low mountains: a case study. Entrep Sustain Issues 2020;7(3):2213–27.
[39] Hannam K. Ayurvedic health tourism in Kerala, India. Health Wellness Tourism 2009:341–4.
[40] Ataberk E, Baykal F. Utilization of natural and cultural resources of Dikili (Izmir) for tourism. Proc Soc Behav Sci 2011;19:173–80.
[41] Fabac R, Zver I. Applying the modified SWOT–AHP method to the tourism of Gornje Međimurje. Tourism Hospit Manag 2011;17(2):201–15.
[42] Marinoski N, Korunovski S. Tourism in Macedonia in changing environment. Proc Soc Behav Sci 2012;44:19–31.
[43] Kim S, Lee J, Jung J. Assessment of medical tourism development in Korea for the achievement of competitive advantages. Asia Pac J Tourism Res 2013;18(5):421–45.
[44] Maini V. Health tourism in India - a SWOT analysis. Int J Res Dev Manag Rev 2013;2(1):73–6.
[45] Barca M, Akdeve E, Balay İG. Strategic analysis of medical tourism in Turkey and strategy recommendations. J Bus Res 2013;5(3):64–92.
[46] Ebrahimzadeh I, Sakhavar N, Taghizadeh Z. A comparative study of health tourism potentials in Iran and India. J Subcontinent Res 2013;5(15):51–78. University Sis & Balu.
[47] Picazo OF. Medical tourism in the Philippines: market profile, benchmarking exercise, and SWOT analysis (No. 2013-45). PIDS Discussion Paper Series. 2013.
[48] Edinsel S, Adıgüzel O. Türkiye'nin sağlık turizmi açısından son beş yıldaki dünya ülkeleri içindeki konumu ve gelişmeleri *(Turkey's health tourism location within the last five years in terms of countries of the world and developments)*. Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 2014;4(2):167–90.
[49] Daştan İ. Health tourism in Turkey: swot analysis of health tourism in Turkey and Izmir, and strategy recommendations. J Soc Sci Inst 2014;6(10):143–63. Mehmet Akif Ersoy University.
[50] Aslan I, Çınar O, Özen Ü. Developing strategies for the future of healthcare in Turkey by benchmarking and SWOT analysis. Proc Soc Behav Sci 2014;150:230–40.
[51] Ghanbari S, Hajinejad A, Rahmani P. Formulating strategic plan of medical tourism development. Int J Travel Med Glob Health 2014;2(4):149–54.
[52] Wong KM, Velasamy P, Arshad TNT. Medical tourism destination SWOT analysis: a case study of Malaysia, Thailand, Singapore and India. In: SHS web of conferences, 12. EDP Sciences; 2014. 01037.
[53] Dincer FI, Dincer MZ, Yilmaz S. The economic contribution of Turkish tourism entrepreneurship on the development of tourism movements in Islamic countries. Proc Soc Behav Sci 2015;195:413–22.
[54] Hosseini SM, Maher A, Safarian O, Ayoubian A, Sheibani-Tehrani D, Amini-Anabad H, Hashemidehaghi Z. Development strategy of health tourism in Iran. Int J Travel Med Glob Health 2015;3(4):153–8.
[55] Emir O, Arslanturk Y. Perceptions of tourism students on thermal tourism in Afyonkarahisar. Proc Soc Behav Sci 2015;176:565–70.
[56] Goodarzi M, Haghtalab N, Shamshiry E. Wellness tourism in Sareyn, Iran: resources, planning and development. Curr Issues Tourism 2016;19(11):1071–6.
[57] Görener A. A SWOT-AHP approach for assessment of medical tourism sector in Turkey. Alphanum J 2016;4(2):159–70.
[58] Tasci ME, Görener A. Evaluating the strategies of medical tourism sector through AHP and Moora in a SWOT framework. J Glob Strateg Manag 2016;10(2):15–30.
[59] Ulaş D, Anadol Y. A case study for medical tourism: investigating a private hospital venture in Turkey. Anatolia 2016;27(3):327–38.
[60] Anish MN, Dhanish PB, Sridharan R. SWOT-AHP analysis in medical tourism area of Kerala. Int J Soc Syst Sci 2017;9(3):256–76.
[61] Khairunnisa C, Hatta M. The development of health tourism industries in Malaysia. Sci J PPI-UKM 2017;4(1):1–11.
[62] Unuvar O, Kaya M, Bilge FA. The term of corporate social responsibility (CSR) in health tourism, sample Projects of CSR in Turkey within the scope of health tourism. Aust Acad Acct Finance Rev 2017;2(3):246–63.
[63] Mohezar S, Moghavvemi S, Zailani S. Malaysian Islamic medical tourism market: a SWOT analysis. J Islam Mark 2017;8(3):444–60.
[64] Ajmera P. Ranking the strategies for Indian medical tourism sector through the integration of SWOT analysis and TOPSIS method. Int J Health Care Qual Assur 2017;30(8):668–79.
[65] Abadi F, Sahebi I, Arab A, Alavi A, Karachi H. Application of best-worst method in evaluation of medical tourism development strategy. Decis Sci Lett 2018;7(1):77–86.
[66] Olyaeemanesh A, Behzadifar M, Mousavinejhad N, Behzadifar M, Heydarvand S, Azari S, et al. Iran's health system transformation plan: a SWOT analysis. Med J Islam Repub Iran 2018;32:39.
[67] Shablii O, Zastavetska L, Dudarchuk K, Illiash I, Smochko N. The main problems of healthcare and wellness tourism in Ukraine. J Geol Geogr Geoecol 2018;27(2):337–45.
[68] Zarchi MKR, Jabbari A, Hatam N, Bastani P, Shafaghat T, Fazelzadeh O. Strategic analysis of Shiraz medical tourism industry: a mixed method study. Galen Med J 2018;7:1021.
[69] Dragičević D, Paleka H. Health tourism market in Poland and Croatia–financial effects and potentials. Tourism South East Europe 2019;5:219–32.

[70] Zouni G, Gkougkoulitsas T. Tourism marketing strategies incorporating both tourists and tourism professionals: the case of Thessaloniki, Greece. In: Cultural sustainable tourism. Cham: Springer; 2019. p. 161–5.
[71] Çevik Onar S, Büyüközkan G, Öztayşi B, Kahraman C. A new hesitant fuzzy QFD approach: an application to computer workstation selection. Appl Soft Comput 2016;46:1–16.
[72] Liu H, Rodríguez RM. A fuzzy envelope for hesitant fuzzy linguistic term set and its application to multicriteria decision making. Inf Sci 2014;258:220–38.
[73] Zhu B, Xu Z, Zhang R, Hong M. Hesitant analytic hierarchy process. Eur J Oper Res 2016;250(2):602–14.
[74] Büyüközkan G, Karabulut Y, Mukul E. A novel renewable energy selection model for United Nations' sustainable development goals. Energy 2018;165:290–302.
[75] Mi X, Wu X, Tang M, Liao H, Al-Barakati A, Altalhi AH, et al. Hesitant fuzzy linguistic analytic hierarchical process with prioritization, consistency checking, and inconsistency repairing. IEEE Access 2019;7:44135–49.
[76] Büyüközkan G, Güler M. Analysis of companies' digital maturity by hesitant fuzzy linguistic MCDM methods. J Intell Fuzzy Syst 2020;38(1):1119–32.
[77] Ohta R, Salomon VA, Silva MB. Classical, fuzzy, hesitant fuzzy and intuitionistic fuzzy analytic hierarchy processes applied to industrial maintenance management. J Intell Fuzzy Syst 2020;38(1):601–8.
[78] Camci A, Temur GT, Beskese A. CNC router selection for SMEs in woodwork manufacturing using hesitant fuzzy AHP method. J Enterprise Inf Manag 2018;31 (4):529–49.
[79] Sun R, Hu J, Zhou J, Chen X. A hesitant fuzzy linguistic projection-based MABAC method for patients' prioritization. Int J Fuzzy Syst 2018;20(7):2144–60.
[80] Xu XG, Shi H, Zhang LJ, Liu HC. Green supplier evaluation and selection with an extended MABAC method under the heterogeneous information environment. Sustainability 2019;11(23):6616.
[81] Liu P, Xu H, Pedrycz W. A normal wiggly hesitant fuzzy linguistic projection-based multiattributive border approximation area comparison method. Int J Intell Syst 2020;35(3):432–69.
[82] Şahin R, Altun F. Decision making with MABAC method under probabilistic single-valued neutrosophic hesitant fuzzy environment. J Ambient Intell Hum Comput 2020:1–18.
[83] Hsu CC, Sandford BA. The Delphi technique: making sense of consensus. Practical Assess Res Eval 2007;12(10):1–8.
[84] Marchais-Roubelat A, Roubelat F. The Delphi method as a ritual: inquiring the Delphic Oracle. Technol Forecast Soc Change 2011;78(9):1491–9.
[85] Aydın D. Health tourism in Turkey. T.C. Ministry of Health General Directorate of treatment services health tourism coordinator. 2011.
[86] Abdel-Basset M, Mohamed M, Smarandache F. An extension of neutrosophic AHP–SWOT analysis for strategic planning and decision-making. Symmetry 2018; 10(4):116.
[87] Beg I, Rashid T. TOPSIS for hesitant fuzzy linguistic term sets. Int J Intell Syst 2013; 28(12):1162–71.
[88] Büyüközkan G, Güler M. Smart watch evaluation with integrated hesitant fuzzy linguistic SAW-ARAS technique. Measurement 2020;153:107353.

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